MANUFACTURE OF PLASTIC POLARIZING LENS

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Abstract

PURPOSE:To manufacture a plastic polarizing lens at high efficiency by introducing a molten plastic into a cavity, in which a spherically premolded polarizing lens element has been placed, to form a plastic base layer fused monolithically to an adhesive surface of the lens element.

CONSTITUTION:A male metal mold 12 is disposed away from a female metal mold 11. A polarizing lens element 6 is suspended from a pin 16 and fitted loosely in a circular recess 11a. The male mold 12 is then pressed against the female mold 11 to hold therebetween a support member 5 for the polarizing lens element 6. A plastic material is introduced under pressure from a gate 15 into a spherical cavity formed by the circular recess 11a and a circular projection 12a. A curved portion of the polarizing lens element 6 can be moved floatingly to a small extent in the cavity mentioned above. Accordingly, the cavity is filled with the plastic material in such a manner that an adhesive surface of a transparent layer, i. e. the lens element 6 is covered smoothly with the plastic material.

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(54) 偏光プラスチックレンズの製造方法

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明　細　書

1　発明の名称

偏光プラスチックレンズの製造方法

2　特許請求の範囲

(1)　偏光素子の両面に積層された透明被覆層の一方がその表面に形成されるプラスチック基剤と接着性を有する結合性表面からなっている偏光シートを球面状に予備成形し、この予備成形された偏光シートの球面外周の平坦部を一定支持片として残して切断することにより偏光レンズ素子を形成し、前記偏光レンズ素子をこれとほぼ同一の曲率からなる1個以上のキャビティを形成する一対の金型の凹形凹部または凹形凸部の周外側に設けられた支持手段に前記支持片を支持せしめることにより結合性表面を外側にして凹形凹部または凹形凸部の表面にのわせるように置く装着し、ついで環状両金型を圧締するとともに溶融プラスチックをキャビティ内に充填して前記偏光レンズ素子の結合性表面にプラスチック基剤を強固一体化することを特徴とする偏光プラスチックレンズの製造方法。

(2)　支持手段が凹形凹部または凹形凸部の周外側に突設されたピンである特許請求の範囲第1項記載の偏光プラスチックレンズの製造方法。

(3)　偏光レンズ素子の直径がキャビティの直径より小さい特許請求の範囲第1項記載の偏光プラスチックレンズの製造方法。

3　発明の詳細な説明

本発明は、防眩用の偏光メガネに使用されるプラスチック製の偏光レンズの製造方法に関す

る。

ほぼ、光学的異方性を有する偏光素子を透明なプラスチック層と積層した構造のプラスチック製の偏光レンズは公知である。たとえば、特公昭53-29711号公報にはこの種レンズの製造方法として、凹面と凸面とからなるモールドによって形成される空隙内に球面状に予備成形した光偏要素を置き、その両側に重合性プラスチック単量体を注入供給してこれをそのまま重合させることにより複合プラスチック光偏光用レンズを形成する、いわゆるキャスト法による製造方法が開示されている。また、特公昭50-3656号公報には、偏光性の基層の両面に厚さの異なる熱可塑性層層を配置した平板状の積層体を、プレスの凹押板と凸押板に挟んで薄い方の熱可塑性層層を凸押板に当ててプレ

(3)

スする、いわゆるプレス成形法による製造方法が開示されている。しかし、前者の方法では重合性プラスチック単量体をモールドと共に十分な時間加熱して重合させなければならないので、製造時間が長くかかり効率が悪く、また効率を高めるには多数対のモールドを必要とするなどの欠点がある。また、後者の方法では偏光性の基層が凸押板によってプレスされる際に、偏光性の基層が両面の熱可塑性積層の変形応力によって亀裂を生ずる傾向があり、また成形最所調整り傾向を示すことも相俟って、加熱プレスの温度と圧力の適用条件範囲が非常に狭くなるという欠点がある。

本発明の目的は、上記のような従来の欠点をとり除くとともに、より生産効率のよいプラスチック製の偏光レンズの製造方法を提供するこ

(4)

とにある。すなわち、本発明の要旨とするところは、偏光素子の両面に積層された透明被覆層の一方がその表面に形成されるプラスチック基層と積層性を有する結合性表面からなっている偏光シートを球面状に予備成形し、この予備成形された偏光シートの球面外周の平坦部を一部支持片として残して切除することにより偏光レンズ素子を形成し、この偏光レンズ素子をこれとほぼ同一の断面からなる1個以上のキャビティを形成する射出成形金型の相違一対の金型の円形凹部または円形凸部の周外側に設けられた支持調整手段により結合性表面を外側にして円形凹部または円形凸部の表面に沿わせるように軽く当接し、ついで前記両金型を圧締するとともに溶融プラスチックをキャビティ内に充填して偏光レンズ素子の結合性表面にプラスチック

(5)

基層を融着一体化する点にあり、得られた球面状の積層体は所定のレンズ形状に周辺を研削することによりプラスチック製の偏光レンズを製造するものである。

本発明において使用される偏光素子は、光学的異方性を有する透明フイルム状体であり、たとえば実質的に一軸方向に分子配向されかつヨウ素あるいは二色性染料で処理されたポリビニルアルコールのフイルム、ハロゲン化ビニル基含有の脱ハロゲン化水素反応によるポリエンを有する重合体を二色性染料で処理し、一軸方向に分子配向されたものなどが適用される。また、上記偏光素子の両面に積層される透明被覆層は偏光素子を保護する役目をなすものであり、これにはセルロースアセテート、セルロースプロピオネート、セルロースアセテートブチレー

(6)

トなどの熱可塑性セルロース誘導体からなるフィルム、その他アクリル系フィルム、塩化ビニル系フィルムなどが適用され、通常偏光素子と接着剤を用いて積層され偏光シートとされる。この場合偏光素子の両面に積層される透明被覆層の少なくとも一方は、後述のプラスチック基層に対して、それ自体が積層性を有するか、またはその表面がたとえば塩化ビニル系フィルム、ABS系フィルム、アクリル系フィルムあるいはアクリル系樹脂などからなる感熱型接着剤層を介して積層性を有するものであり、成形時のプラスチック基層に対して結合性を発揮する表面を有する。そしてこの結合性表面を有する透明被覆層はプラスチック基層の片面に必じ選択的に使用される。

また、本発明において使用されるプラスチック基層としては、ポリメチルメタクリレートなどのアクリル系重合体が好適である。

以下、本発明を実施例を示す図面に従って詳細に説明する。なお、本発明においては偏光レンズ素子とプラスチック基層との積層構造の積層上いずれを凹面側としていずれを凸面側とするかは任意であるが、以下に説明する実施例においては主として偏光レンズ素子を凸面側にプラスチック基層を凹面側に積層する場合について述べる。

第1図は、偏光素子(1)の両面に透明被覆層(2)および(3)が積層された偏光シート(4)が、加熱プレス成形によつて透明被覆層(3)が凹面側となるように球面Rに予備成形された状態を示す。球面Rの直径と曲率は、後述の雌金型の円形凹部の直径および曲率とほぼ等しい。ここで凸面側

(7)

(8)

の透明被覆層(2)は熱可塑性セルロース誘導体からなるフィルムであり、また凹面側の透明被覆層(3)はアクリル系フィルムである。偏光シート(4)を構成する各層の厚さは、偏光シート(4)の予備成形の際、偏光素子(1)の光学的直方性と球面Rの凹凸両面の表面状態を最適に保つために配慮され、さらに後述の第6図に示すプラスチック基層(9)との一体化の際、偏光シート(4)のしわ、破れ、とりわけ偏光素子(1)に亀裂などの生じないようにするために好適な厚さとすることが肝要である。また、偏光シート(4)の厚さは後述のプラスチック基層(9)との一体化後の積層厚さが最終目的製品としての偏光プラスチックレンズに最適となるよう配慮される。したがつて、好ましくは偏光素子(1)は15μ～75μ、透明被覆層(2)は35μ～350μ透明被覆層(3)は30

μ～200μの範囲の厚さとする。予備成形の方法は、特殊な方法を必要とせず、たとえば130℃～150℃に熱せられた凸金型と常温の凹金型との間に透明被覆層(2)が凹金型に接するように配置し凸金型を透明被覆層(3)側から凹金型に押込み加圧したのち取り出して冷却すればよい。

第2図は、前記予備成形で得られた偏光シート(4)の球面Rの外周の平坦部の一部を支持片(5)として残して切除した偏光レンズ素子(6)を示すものである。この場合、球面Rの周縁で切除するほか、周縁よりわずかに内方(第1図の破線(4)で示す。)位置で切除することが許され、これによつて後述のプラスチック基層(9)との一体化に好ましい影響をもたらすことができる。支持片(5)は、後述の第3～4図に示される支持手

(9)

(10)

段(8)により、偏光レンズ素子(6)を取付ける役目をする。なお、(7)は取付用穴であり、支持片(5)の上方中央部に設けられる。この取付用穴(7)は1個に限らず2個以上あってもよい。

上記により得られた偏光レンズ素子(6)は、ついで射出成形法により、プラスチック基層(2)と融着一体化される。第3図は、射出成形装置の概略一対の金型の開放状態を示す縦断面図である。(1)は固定された雄金型であり、(2)は雄金型(1)に向き合ってこれに任接、離反を繰り返し移動する雌金型である。第4図は、雄金型(1)の正面図であり、第5図は、雌金型の正面図である。雄金型(1)には円形凹部(11a)が設けられており、これに対向して雌金型(2)には円形凸部(12a)が設けられている。雌雄両金型(1)(2)が任接状態にあるとき円形凹部(11a)と円形凸部(12a)によ

(1)

って、キャビティが形成される。(3)は押出装置(図示していない。)で溶融されたプラスチック基層(2)を形成するプラスチック材料を上記キャビティに向けて一定量矢印方向に供給するための主ランナーである。(4)および(4')は主ランナー(3)から上記キャビティ内に最終的にプラスチック材料を供給するためのゲート(5)に至るランナーである。ゲート(5)は、本実施例においてはキャビティ内に供給される溶融されたプラスチック材料が均一にキャビティ内に流入され、よってプラスチック基層(2)内に歪を生ぜしめないようにするためにキャビティ内に向って順次拡開状の広幅でかつ扁平状の開口部を形成する場所となされている。(6)は円形凹部(11a)の周辺部に設けられた偏光レンズ素子(6)を取付けるための支持手段であり、この実施例では、

(2)

~~その好ましい一例として~~第3図にも示すように、前記支持片(5)の取付用穴(7)に挿入して偏光レンズ素子(6)を吊持状態に支持するピンとして構成される。この支持状態において、偏光レンズ素子(6)は、その結合表面を有する透明被覆層(3)すなわち凹面側を外側として、円形凹部(11a)内に沿わせるように置く、僅かに遊動可能の状態に置換される。第3図に示すピン(6)は、雄金型(1)面に垂直に固設固定されたものであるが、これに限定されるものではなく、たとえば雄金型(1)に内蔵されたバネにより雄金型(1)の正接時には後退し、離反時には突出する方式の可動ピンであってもよく、また本数は1本に限定されず2本以上であってもよい。この場合、ピン(6)の本数および位置は前記偏光レンズ素子(6)の取付用穴(7)に対応することはいうま

(3)

でもない。なお、(6)はピン(6)が雄金型(1)に固設固定されている場合のピン(6)の嵌入孔であり、ピン(6)が上記の可動ピンである場合は不要である。(8)は成形完了後に成形物を雄金型(1)から引離し、雌金型(2)から突き離すための通常のゼットピンである。

つぎに、偏光レンズ素子(6)とプラスチック基層(2)との融着一体化について順を追って説明する。まず、雌金型(2)を雄金型(1)から離反させておき、偏光レンズ素子(6)を取付用穴(7)によってピン(6)に吊り下げ状に取付ける。従ってこのとき、偏光レンズ素子(6)の凸面側は、円形凹部(11a)の表面に接着されることなく、それに沿わせられて僅く離間された状態となる。この場合ピン(6)を2本またはそれ以上使用すれば、偏光レンズ素子(6)と円形凹部(11a)との相対位置をより

(4)

確実に一致せしめることができる。ついで、型金型(3)を移動して型金型(4)に圧接せしめ、偏光レンズ基子(6)の支持片(5)を挟持するとともに、円形凹部(11a)と円形凸部(12a)とによつて形成される曲面状のキャビティ内にゲート(9)からプラスチック材料を圧入する。このとき、偏光レンズ基子(6)は、その支持片(5)の部分では挟持されているが曲面Rの部分はキャビティ内で若干移動し得る状態で透明被覆層(2)の表面が円形凹部の表面に接触しているので、溶融状態のプラスチック材料の流入に対し極度に抵抗することはなく、プラスチック材料が円滑に透明被覆層(3)の結合性表面を覆うように充填されるから、それ程しわが生じたり、あるいは偏光基子(6)に応力を生じたりすることがない。なお偏光レンズ基子(6)として、第1図の破線で示す部分、

すなわち予備成形で得られた偏光シート(4)の曲面Rを円縁よりわずか(たとえば1～2㎜)に内方部分で切除したものを用いると上記の過程でプラスチック材料をより円滑に充填させることが可能であり、より好結果をもたらすことができる。このようにして、プラスチック材料は偏光レンズ基子(6)をその凹面側から円形凹部(11a)の表面に圧しつけるように流入され、キャビティ内に充填されるとともに透明被覆層(3)の結合性表面に融着一体化され、固化される。その結果、透明被覆層(2)の表面は円形凹部(11a)によつて、またプラスチック材料が圧入されてできたプラスチック基層の表面は円形凸部(12a)によつてそれぞれ規制された曲面精密体が得られる。なお得られた曲面精密体は型金型(3)および(4)を離反し、ゲートピン(8)によつて射出成

形品部外にとり出す。引続き上記の操作が繰り返される。

以上によつて得られた曲面精密体は、第6図に示すように周縁を所定の形状に研削し目的とする偏光プラスチックレンズ(2)とされる。なお、曲面精密体の表面に周知の方法により硬化被膜を形成することは任意である。

上記実施例のほか、本発明においては、第7図に示すように偏光レンズ基子(6)を凹面側にプラスチック基層(1)を凸面側に配し偏光プラスチックレンズ(2)を得ることもできる。この場合は、原理的には上述の偏光プラスチックレンズ(2)を得る方法と変わるところはないが、若干相違する点について以下にその一点を説明とする。

すなわち、偏光シート(4)から偏光レンズ基子(6)を予備成形する際に凹面側を透明被覆層(2)とし凸

面側を結合性表面を有する透明被覆層(3)とすることであり、その他の点においては第1図と同様である。また射出成形装置にも若干構造上および操作上の相違がある。すなわち、第8図において示すように型金型(3)の円形凹部(31a)側に、キャビティにプラスチック材料を最終的に供給するゲート部が設けられ、また偏光レンズ基子(6)を、その結合性表面を有する透明被覆層(3)すなわち凸面側を外側として円形凸部(32a)の表面に沿わせるようにして軽く当接する。従つてこの支持手段としてのピン(8)は、円形凸部(32a)の周外側に構設される。かくして、前述の実施例と同様にして操作をすればプラスチック材料は円形凹部(32a)側から圧入充填され偏光レンズ基子(6)の凸面側に融着一体化され固化される。以下前述の実施例と同様にして、第7

図に示す偏光レンズ素子(6)を凹面側に、プラスチック基層(2)を凸面側に有する偏光プラスチックレンズ(10)を得ることができる。

本発明は、以上述べた通り通常の射出成形法を利用することにより、偏光レンズ素子を金型内に位置せるようにして軽く密着した状態でその結合性表面に溶融状態のプラスチック材料と溶融一体化するものであるから、偏光素子に亀裂を生じたりすることがなく、また透明被覆層にしわが生じたり、破れたりすることもなく、しかも透明被覆層およびプラスチック基層の表面が極めて良好に仕上がるので、光学的欠点の無い偏光プラスチックレンズを得ることができる。また射出成形法を利用するため、従来の方法に比べ偏光レンズ素子とプラスチック基層との一体化が極めて短時間になし得られて効率的

であり、偏光プラスチックレンズの量産に適している。

4 図面の簡単な説明

図面はいずれも本発明の一実施例を示すものであり、第1図は予備成形された偏光シートの構成を示す断面図、第2図は偏光レンズ素子を示す凸面側からみた部分切欠平面図、第3図は射出成形装置の雌雄金型の開反した状態を示す部分縦断面図、第4図は雄金型を、また第5図は雌金型をそれぞれ示す正面図、第6図は本発明の一実施例によつて得られる偏光プラスチックレンズを示す断面図、第7図は他の実施例によつて得られる偏光プラスチックレンズを示す断面図、第8図は第7図で示す偏光プラスチックレンズを得るための射出成形装置の雌雄金型を開反せしめた状態でその要部を示す部分縦断

面図である。

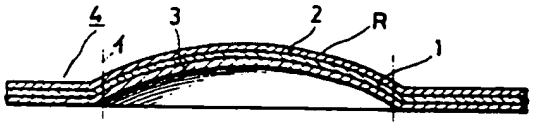
(1)…偏光素子、(4)…偏光シート、(5)…支持片、(6)…偏光レンズ素子、(11)(31)…雄金型、(11a)(31a)…円形凹部、(12)(32)…雌金型、(12a)(32a)…円形凸部、(16)…ピン(支持手段)、(2)…プラスチック基層、(10)…偏光プラスチックレンズ。

以上

特許出願人 岩吉光学工業株式会社

代理人 弁理士 増 永 久 雄

第1図



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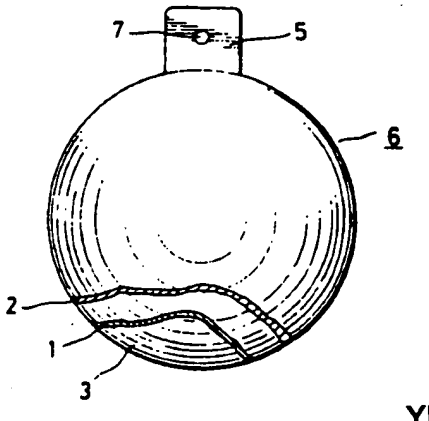

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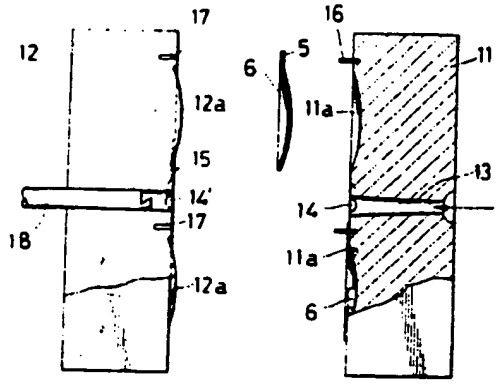
第3図



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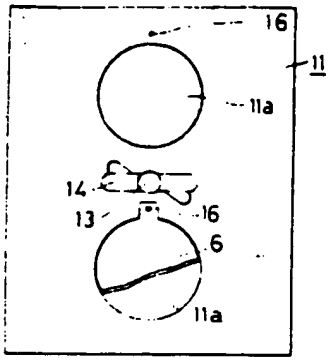

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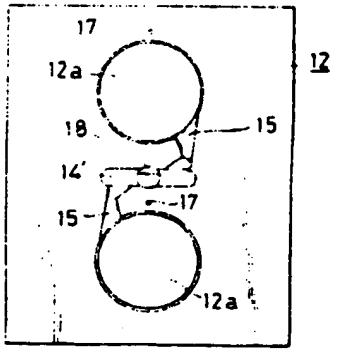
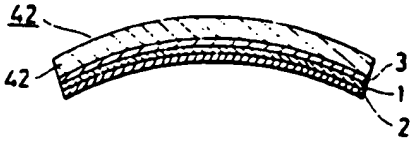
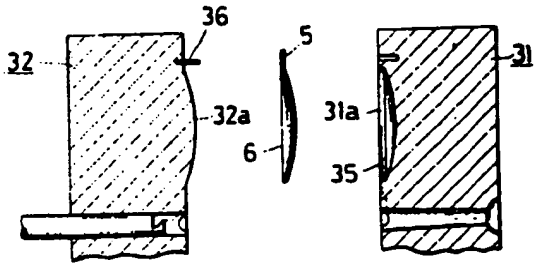


第6図

第7図



第8図



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(54) Title of invention: Manufacturing method of a polarized plastic lens

(21) Japanese Patent Application: S54-88924
(22) Date of application: July 12, 1979
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Specifications

1. Title of Invention

MANUFACTURING METHOD OF A POLARIZED PLASTIC LENS

2. Scope of Patent Claims

(1) A manufacturing method of a polarized plastic lens wherein:

a polarized sheet is pre-formed into a spherical shape in which one of the transparent covering layers laminated on both sides of a polarized element comprises a bondable surface capable of being laminated with a plastic substrate that is to be molded on the surface thereof;

a polarized lens element is formed by cutting and leaving as a support piece a flat part outside of the spherical surface of the pre-formed polarized sheet;

the aforementioned polarized lens element is loosely mounted such that the surface of the circular concave part or circular convex part with the bondable surface is lined up to the outside by supporting the aforementioned support piece on a support means provided outside of the circular concave part or convex part of a pair of dies that form one or more cavities comprising a curve nearly the same as that of the polarized lens element; and

a plastic substrate is fused and unified to the bondable surface of the aforementioned polarized lens element by filling the interior of the cavity with molten plastic in conjunction with pressing the male and female dies together.

(2) A manufacturing method of a polarized plastic lens described in Claim 1 wherein the support means is implanted outside of the circular concave part or circular convex part.

(3) A manufacturing method of a polarized plastic lens described in Claim 1 wherein the diameter of the polarized lens element is smaller than the diameter of the cavity.

3. Detailed Explanation of the Invention

The present invention is related to the manufacturing method of polarized lenses made of plastic that are used for polarized glasses to protect from glare.

Polarized lenses made of plastic with a structure in which optically anisotropic polarized elements are laminated with a clear plastic layer are well known. For example, disclosed in Japanese Examined Patent Application Publication S53-29711 is a manufacturing method for this kind of lens. This manufacturing method is based on the so-called cast method in which a polarized element pre-formed into a spherical shape is placed in a space formed by a mold comprising concave and convex surfaces. A polymerizable plastic monomer is supplied by infusion to both sides, and a composite plastic polarized lens is formed by polymerization. Moreover, disclosed in Japan Examined Patent Application Publication S50-3656 is a manufacturing method based on the so-called press mold method in which a flat laminate body, having thermoplastic layers of differing thicknesses arranged on both surfaces of a polarized thin film, is placed between concave and convex press plates of a press, and the thermoplastic layers are pressed together from the top using a convex press plate. However, the former method has the disadvantage that the manufacturing time is lengthy and rather inefficient because the polymerizable plastic monomer must be heated and polymerized for a sufficient amount of time together in the mold, and it is necessary to have multiple pairs of molds in order to heighten the efficiency. In addition, when pressing the polarized thin film using the convex press plate in the latter method, there is a tendency for the molding stress of the thermoplastic laminates to crack the polarized thin film. There is also the disadvantage that there is a tendency toward delamination after molding, and thus the range of applicable conditions for temperature and pressure of the heating press are extremely narrow.

The objectives of the present invention are to eliminate the disadvantages of conventional technology as described above, and to offer a method of manufacturing a polarized lens made of plastic with higher production efficiency. Specifically, the gist of the present invention is to manufacture a plastic polarized lens wherein: a polarized sheet is pre-formed into a spherical shape in which one of the transparent covering layers laminated on both sides of a polarized element comprises a bondable surface capable of being laminated with a plastic substrate that is to be molded on the surface thereof; a polarized lens element is formed by cutting and leaving as a support piece a flat part outside of the spherical surface of the pre-formed polarized sheet; the aforementioned polarized lens element is loosely mounted such that the surface of the circular concave part or circular convex part with the bondable surface is lined up to the outside by supporting the aforementioned support piece on a support means provided outside of the circular concave part or convex part of a pair of dies that form one or more cavities comprising a curve nearly the same as that of the polarized lens element; and a plastic substrate is fused and unified to the bondable surface of the aforementioned polarized lens element by filling the interior of the cavity with molten plastic in conjunction with pressing the male and female dies together. A plastic polarized lens is produced from the spherical laminate obtained by grinding the outer edge into the specified lens shape.

The polarized element used in the present invention is an optically anisotropic transparent film. For example, a polyvinyl alcohol film is used in which the molecules are substantially oriented in one axial direction and which was processed with iodine or a bicolor dye. That is, a film with the molecules oriented in one axial direction is used in which a polymer having a polychloride based on a hydrogen dehalogenation reaction of a halogenated vinyl group polymer was processed with a bicolor dye. Transparent covering layers that are laminated on both sides of the aforementioned polarized element play the role of protecting the polarized element. Films comprising thermoplastic cellulose derivatives such as cellulose acetate, cellulose triacetate, and cellulose acetate butyrate, as well as other acrylic group films and vinyl chloride group films may be used for

this, laminated with an ordinary polarized element using an adhesive, and taken as the polarized sheet. In this situation, at least one of the transparent covering layers laminated on both sides of the polarized element is to be capable of lamination with the plastic of the previously described plastic substrate, or that surface is to be capable of lamination via a thermo-sensitive adhesive film comprising, for example, a vinyl chloride group film, an ABS group film, an acrylic group film, or a acrylic resin. The transparent covering film is to have a surface that manifests bonding characteristic in relation to the plastic substrate when molten. The transparent covering layer having a bondable surface is to be selected corresponding to the type of plastic substrate.

In addition, an acryl group polymer such as polymethylmethacrylate is suitable as the plastic substrate used in the present invention.

The present invention will be explained in detail below using the diagrams indicating an example of embodiment. Further, the structural relationship of the laminate of the polarized lens element and the plastic substrate in the present invention may be either on the concave side or the convex side, but in the example of embodiment explained below, the description is primarily for when laminating the concave side of the plastic substrate onto the convex side of the polarized lens element.

Figure 1 indicates the state when a polarized sheet (4), in which transparent coverings (2) and (3) are laminated on both surfaces of a polarized element (1), has been pre-formed into spherical surface R such that the transparent covering layer (3) is made into the concave side by heat press molding. The diameter and curvature of spherical surface R is nearly equivalent to the diameter and curvature of the circular concave part of the male die to be described later. Here, transparent covering layer (2) on the convex side is a film comprising a thermal plastic cellulose derivative, and transparent covering layer (3) on the concave side is an acrylic group film. The thickness of the various layers configuring the polarized sheet (4) should be carefully considered in order to maintain the optical anisotropy and the surface conditions of both the concave and convex surfaces of spherical surface R of the polarized element (1) when pre-molding the polarized sheet (4). Further, it is important to make a suitable thickness in order to prevent wrinkling or tearing of the polarized sheet (4), and especially to prevent cracking of the polarized element (1), when unifying with the plastic substrate (21) indicated in Figure 6, as will be described later. Moreover, the thickness of the polarized sheet (4) should be carefully considered in order to make the thickness of the laminate after unification with the plastic substrate (21) (to be described later) the optimum size for the polarized plastic lens that is targeted as the final product. Consequently, the thickness of the polarized element is preferably in the range of 15 to 75 μ, the thickness of the transparent covering layer (2) should be in the range of 35 to 350 μ, and the transparent covering layer (3) should be in the range of 30 to 200 μ. The method of pre-molding is not necessarily a special method. For example, the transparent covering layer (2) may be arranged between a convex die that is heated to 130 to 150°C and a concave die at room temperatures such that the transparent covering layer (2) makes contact with the concave die. After pressing and pressurizing the convex die into the concave die from the transparent covering layer (3) side, the convex die may be removed and water-cooled.

Figure 2 indicates a polarized lens element (6) wherein one part of the flat area outside the spherical surface R of the polarized sheet (4) obtained by the aforementioned pre-molding is cut and left as a support piece (5). In this situation, when cutting the peripheral edge of the spherical surface R, it is permissible to cut in a position somewhat inside from the peripheral edge (indicated by the dotted line (a) of Figure 1). By doing this it is possible to exert a desirable affect on unification with the plastic substrate (21) to be described later. The support piece (5) plays a role in assembling the polarized lens element (6) by using a support means (16) indicated in Figures 3 to 4 to be described later. Further, (7) is an assembly hole, and is provided on the upper central part of the support piece (5). This assembly hole (7) is not limited to being a single hole, and there may be two or more.

The polarized lens element (6) obtained as above is next fused and unified with the plastic substrate (21) by injection molding. Figure 3 is a longitudinal cross-sectional diagram indicating the open state of a pair of male and female dies of the injection mold equipment. (11) is the female die that is stationary and (12) is the male die that mates with the female die (11) and moves to make repeated pressure contact and release. Figure 4 is a top view diagram of the female die (11), and Figure 5 is a top view diagram of the male die. A circular concave part (11a) is provided on the female die (11), and a circular convex part (12a) is provided opposite to this on male die (12). When the male and female dies (11) and (12) are in the pressure contact state, a cavity is formed by the circular concave part (11a) and the circular convex part (12a). (13) is the main runner for the purpose of supplying in the direction of the arrow toward the aforementioned cavity the plastic material to form the plastic substrate (21) that has been melted by the extrusion device (not indicated in the diagram) in a fixed quantity. (14) and (14') are runners extending from the primary runner (13) to the gate (15) for the purpose of ultimately supplying plastic material within the aforementioned cavity. The gate (15) has a structure wherein the molten plastic material supplied within the cavity of the present example of embodiment is infused into the cavity uniformly, and a gradually broadening fan shaped opening is formed facing the cavity so that no distortions are produced within the plastic substrate (21). (16) is a support means for assembling the polarized lens element (6) provided on the periphery of the circular concave part (11a). In this example of embodiment, as indicated by a preferable example in Figure 3, the support means (5) is configured as a pin that supports the polarized lens element (6) in a suspended state by inserting this pin into the assembly hole (7) of the aforementioned support piece (5). In this supported state, the polarized lens element (6) has the transparent covering layer (3) having the bondable surface to the outside, specifically, the concave surface is to the outside, and is loosely mounted with a little free play in order to mate with the inside of the circular concave part (11a). The pin (16) indicated ~~in Figure 2~~ in Figure 3 is implanted and secured perpendicular to the female die (11) plane, but it is not limited to this. For example, the pin (16) may be movable in a system in which the pin retreats when making pressure contact with the male die (12) based on a spring mounted inside of the female die (11), and the pin protrudes out when the die is released. Moreover, the number of pins is not limited to one, and there may be two or more. In this case, naturally, the number and positions of the pins (16) will correspond to the assembly holes (17) of the aforementioned polarized lens element (6). (17) is the insertion hole of the pin (16) when implanting and securing the pin (16) in the female die (11), and this hole is not necessary if the pin (16) is a movable pin as described above. (18) is an ordinary set pin for the purpose of drawing and releasing the molded product from the female die (11) after completion of molding, and for pressing and releasing from the male die (12).

[stamp: corrected]

Next, an explanation will be given following the order of fusion and unification of the polarized lens element (6) and the plastic substrate (21). First, the male die (12) is separated from the female die (11), and the polarized lens element (6) is assembled by being suspended on the pin (16) via the installation hole (7). Consequently, the convex side of the polarized lens element (6) is not secured to the surface of the circular concave part (11a), but rather is loosely mounted in line with this. In this situation, if two or more pins (16) are used, it is possible to make the relative positions of the polarized lens element (6) and the circular concave part (11a) agree more reliably. Next, the male die (12) is moved to make pressure contact with the female die (11), and the support piece (5) of the polarized lens element (6) is tightly held. Moreover, the plastic material is pressure injected from the gate (15) into the curved cavity formed by the circular concave part (11a) and the circular convex part (12a). At this time, the polarized lens element (6) is closely held by its support piece (5) part, but the part of curve R can somewhat freely move within the cavity. In this state, the surface of the transparent covering layer (2) is fused with the surface of the circular concave part.

Therefore, there is no undue resistance to the flow of the molten plastic material. Because the plastic material is smoothly charged so as to cover the bondable surface of the transparent covering layer (3), there is no spontaneous wrinkling and no cracking of the polarized element (1). It is possible to more smoothly charge the plastic material in the above process and to obtain more satisfactory results when using the part indicated by the dotted lines in Figure 1 as the polarized lens element (6), specifically, when using a piece in which the spherical surface R of the pre-formed polarized sheet (4) that has been cut with a slightly smaller circular edge to the inside part (for example 1 to 2 mm). In this way, the plastic material flows and is filled into the interior of the cavity such that the polarized lens element (6) is pressed onto the surface of the circular concave part (11a) from the concave side. The plastic material is fused and unified with the bondable surface of the transparent covering layer (3) and is solidified. As a result, a curved laminate is obtained in which the surface of the transparent covering layer (2) is restricted by the circular concave part (11a), and the surface of the plastic substrate made by the injection of the plastic material is restricted by the circular convex part (12a). The male and female dies (12) and (11) are separated, and the set pin (18) is used to extract the curved laminate thus obtained from the injection molding equipment. The above operations are subsequently repeated.

The circumference of the curved laminate obtained by the above operations is ground to the specified shape as indicated in Figure 6, and thus becomes the targeted polarized plastic lens (22). Forming a hardened covering film on the surface of the curved laminate using a well-known method is optional.

In addition to the example of embodiment above, in the present invention it is possible to obtain a polarized plastic lens (42) in which the polarized lens element (6) is arranged on the concave side and the plastic substrate is arranged on the convex side as indicated in Figure 7. In this situation, there is, in principle, no difference from the method of obtaining the polarized plastic lens described above, and the points that differ slightly will be explained below.

First, assuming that, when pre-forming the polarized lens element (6) from the polarized sheet (4), transparent covering layer (2) is on the concave side, and that the transparent covering layer (3) has a bondable surface on the convex side, everything else is the same as in Figure 1. In addition, there are slight structural and operational differences in the injection molding equipment. Specifically, as indicated in Figure 8, the gate that ultimately supplies the plastic material to the cavity is provided on the circular convex part (31a) of the female die (31). The polarized lens element (6) is mounted loosely to line up with the surface of the circular convex part (32a) on the transparent covering layer (3) side, specifically, on the convex side, having the bondable surface. Consequently, the pin (36) that is the support means is implanted on the outer peripheral side of the circular convex part (32a). When implementing the same operations as in the previously described example of embodiment, the plastic material is infused and filled from the circular concave part (32a) side, and the plastic material is fused, unified and solidified on the convex surface side of the polarized lens element (6). As indicated in Figure 7, a polarized plastic lens (42) having the plastic substrate (21) on the convex side is obtained in the same manner as in the previously described example of embodiment above.

With the present invention, the polarized lens element is mounted loosely to line up with the interior of the die and the molten plastic material is fused and unified with the bondable surface of the polarized lens element. Therefore, using the ordinary injection molding equipment described above, a polarized plastic lens can be obtained without cracking of the polarized element, without wrinkling of the transparent covering layer, without breakage, and without optical defects owing to an extremely satisfactory finish of the transparent covering layer and plastic substrate surfaces. Because injection molding is used, the polarized lens element and the plastic substrate can be unified with greater efficiency and in a much shorter period of time

than is required in conventional methods, making the method of the present invention suitable for the mass production polarized plastic lenses.

4. Brief Description of the Diagrams

All of the diagrams indicate an example of embodiment of the present invention. Figure 1 is a cross-sectional diagram indicated the configuration of the pre-formed polarized sheet. Figure 2 is a partial cut-away side view indicating the polarized lens element seen from the convex side. Figure 3 is a partial longitudinal cross-sectional diagram indicating the separated male and female dies of the injection molding equipment. Figures 4 and 5 are top view diagrams indicating the female and male dies respectively. Figure 6 is a cross-sectional diagram indicating a polarized plastic lens obtained by one example of embodiment of the present invention. Figure 7 is a cross-sectional diagram indicating a polarized plastic lens obtained by another example of embodiment of the present invention. Figure 8 is a partial longitudinal cross-sectional diagram indicating the essential parts when separating the male and female dies of the injection molding equipment in order to obtain the polarized plastic lens indicated in Figure 7.

(1)	Polarized element
(4)	Polarized sheet
(5)	Support piece
(6)	Polarized lens
(11), (31)	Female die
(11a), (31a)	Circular concave part
(12), (32)	Male die
(12a), (32a)	Circular convex part
(16), (36)	Pin (support means)
(21)	Plastic substrate
(22), (42)	Polarized plastic lens

END

Patent applicant: Wakayoshi Optical Co., Ltd.
Agent: Hisayoshi Kiyomizu

Figure 1

Figure 2

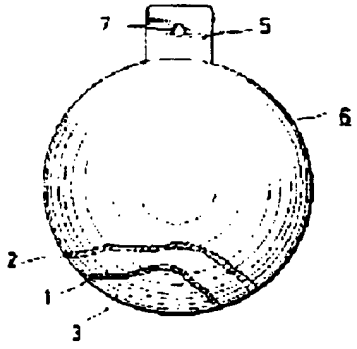


Figure 3

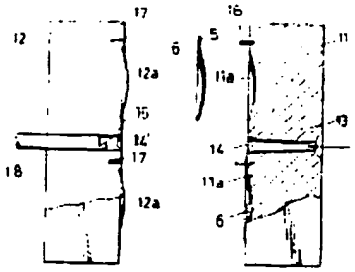


Figure 4

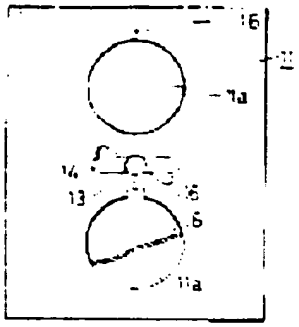


Figure 5

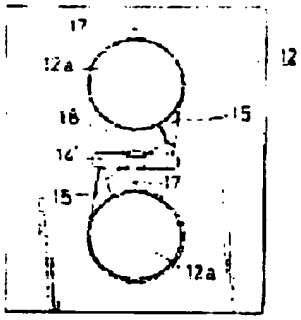


Figure 6

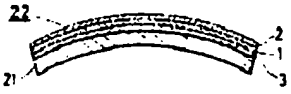
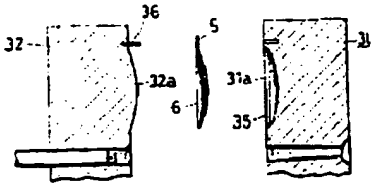


Figure 7

Figure 8



Japanese Patent Laid-Open No. 151211/1981

(Public Date: Feb. 9, 1981)

(3)

Inventor: Wakayoshi, Yoshiaki Assignee: Wakayoshi Kogaku Kogyo KK

SPECIFICATION

1. TITLE OF THE INVENTION

METHOD OF MAKING POLARIZING PLASTIC LENS

2. CLAIMS

1. A method of making a polarizing plastic lens comprising the steps of: preforming polarizing sheets in a spherical shape, in which one of transparent coatings laminated to both sides of a polarizing element is a combining surface to be laminated to a plastic substrate formed thereof; forming a polarizing lens element by cutting the preformed polarizing sheet with leaving a part of a flat portion at an outer circumference of the spherical polarizing sheet as a hanger portion; supporting the hanger portion to a support means installed out of a peripheral of a pair of mold circular concave portions or a circular convex portion which forms at least one cavity with a curvature substantially similar to the polarizing lens element, in order to mount the polarizing lens element to a surface of the circular concave portion or circular convex portion at a gentle slope in manner of putting the combing surface as a outer surface; and welding and integrating the plastic substrate to the combining surface of the polarizing lens element by compressively combining both the concave mold and the convex mold and charging melt plastic material into the cavity at the same time.

2. The method of making a polarizing plastic lens of claim 1, wherein the support means is a pin inserted into the outer circumference of the circular concave or convex portion.

3. The method of making a polarizing plastic lens of claim 1, wherein the diameter of the polarizing lens element is small than that of the cavity.

3. DETAILED DESCRIPTION OF THE INVENTION

The présent invention relates to a method of making a plastic polarizing lens used for an anti-dazzle polarizing lens.

Conventionally, the plastic polarizing lens in a structure that a polarizing element with optical anisotropy is laminated with a transparent plastic layer is well known. For example as a method of making such a kind of lens, Japanese Patent Gazette Publication No.S53-29711 discloses a method of using a so-called cast manner, which forms a complex plastic polarizing lens by arranging a preformed polarizing element in a spherical shape in a airspace formed by a mold consisting of a concave surface and a convex surface, supplying polymerized plastic monomers at both sides of the polarizing element, and then polymerizing them as they are. And, Japanese Patent Gazette Publication No.S50-3656 discloses a method of using a so-called press forming manner, which, with a laminated material having two thermoplastic

layers with different thickness at both sides of a polarizing lamina, presses the thinner thermoplastic layer inserted between a concave press plate and a convex press plate of the press toward the convex press plate. However, the former should heat and polymerize the polymerized plastic monomers together with the mold during a sufficient time, so giving bad efficiency due to the long manufacturing time, and there are additional drawbacks like it needs several pairs of molds to enhance the efficiency. Moreover, in the later method, the polarizing laminar tends to create cracks owing to strains of the thermoplastic layers at both sides thereof when the polarizing laminar is pressed by the convex press plate, and the method has more defects that the polarizing laminar tends to recover its original state after the forming and there is a serious limitation in temperature and pressure conditions applied to the heating press.

An object of the present invention is to provide a method of making a plastic polarizing lens with better manufacturing efficiency, which also eliminates such conventional drawbacks. That is, the object of the present invention is to provide a method of making a plastic polarizing lens, which includes preforming polarizing sheets in a spherical shape, in which one of transparent coatings laminated to both sides of a polarizing element is a combining surface to be laminated to a plastic substrate formed thereof; forming a polarizing lens element by cutting the preformed polarizing sheet with leaving a part of a flat

portion at an outer circumference of the spherical polarizing sheet as a hanger portion; supporting the hanger portion to a support means installed out of a peripheral of a pair of mold circular concave portions or a circular convex portion which forms at least one cavity with a curvature substantially similar to the polarizing lens element, in order to mount the polarizing lens element to a surface of the circular concave portion or circular convex portion at a gentle slope in manner of putting the combing surface as a outer surface; and welding and integrating the plastic substrate to the combining surface of the polarizing lens element by compressively combining both the concave mold and the convex mold and charging melt plastic material into the cavity at the same time, wherein the spherical laminated material is made into the plastic polarizing lens by grinding its periphery into a predetermined lens shape.

The polarizing element used in the present invention is a transparent film configuration with the optical anisotropy, which may be, for example, a polyvinyl alcohol film having molecular substantially oriented to one axis and at the same time treated with urea or 2-color dye or one made by treating the polymer having polyene by the dehalogenation hydrogen reaction of halogenide vinyl polymer with 2-color dye and having molecular oriented to one axis. And, the transparent coatings laminated to both sides of the polarizing element act for protecting the polarizing element, and as the transparent coating, a film consisting of thermoplastic

cellulose derivative such as cellulose acetate, cellulose tri-acetate, cellulose acetate butylate, etc., other acrylic film, vinyl chloride film, and so on may be adopted, and it becomes the polarizing sheet by being laminated to the common polarizing element using adhesive.

In this case, at least one of the transparent coatings laminated to both sides of the polarizing element has a laminating characteristic to a plastic substrate explained below, or its surface has a laminating characteristic by interposing a heat-sensitive adhesive paint film made of, for example, vinyl chloride film, ABS film, acrylic film or acrylic resin, and it has a surface which exhibits a combining characteristic toward the plastic substrate in melting. And, the transparent coating having the combining surface is selectively used depending on the kind of the plastic substrate.

In addition, as the plastic substrate used in the present invention, the acrylic polymer like polymetylmetacrylate is suitable.

Hereinafter, the present invention is described in detain with reference to the drawings showing embodiments. In addition, considering the laminating configuration of the polarizing lens element and the plastic substrate, it can be optionally selected which one is laminated to a concave portion and which other one is laminated to a convex portion in the present invention, but in the embodiments explained below, the explanation will be mainly based on the case that

the polarizing lens element is laminated to the convex portion and the plastic substrate is to the concave portion.

Fig. 1 is shows that a polarizing sheet (4) in which transparent coatings (2) and (3) are laminated on both sides of a polarizing element is preformed on a sphere R so that the transparent coating (3) becomes concave by a heating press. The sphere R has diameter and curvature substantially equal to those of a circular concave portion. At this case, the transparent coating (2) toward a convex surface is a film made of a thermoplastic cellulose derivative, while the transparent coating (3) toward the concave surface is a acrylic film. A thickness of each layer constituting the polarizing sheet (4) is determined to maintain the optical anisotropy of the polarizing element (1) and a concave and convex surface condition of the sphere R at their optimal states, and it is important that each layer should have a suitable thickness to prevent creation of cockle or breakage of the polarizing sheet (4) and, more than else, cracking on the polarizing element (1). And, a thickness of the polarizing sheet (4) is determined so that a laminated thickness after being integrated with a plastic substrate explained below should be suitable to the polarizing plastic lens, which is the finally-purposed product. Therefore, preferably, the polarizing element (1) has a thickness of 15μ ~ 75μ, the transparent coating (2) has a thickness of 35μ ~ 350μ, and the transparent coating (3) has a thickness of 30μ ~ 200μ. The preparatory forming method needs any special

process, but just positioning the transparent coating (2) between a convex mold heated to 130°C ~ 150°C and a concave mold at a room temperature to contact with the concave mold, pressing the convex mold from the transparent coating (3) to the concave mold to put the transparent coating (2) thereinto, and then taking out and cooling it.

FIG. 2 shows a polarizing lens element (6), cutting with leaving a part of an outer circumferential flat portion of the sphere R of the polarizing sheet (4) obtained by the preparatory forming process as a hanger portion (5). In this case, besides cutting the circumferential peripheral of the sphere R, it is also possible to cut off a position a bit inside the circumferential peripheral (shown as a broken line (イ) in FIG. 1), which may give preferable results to integration with a plastic substrate (21) explained below. The hanger portion (5) plays a role of mounting the polarizing lens element (6) by using a support means (16) shown in FIGs. 3 and 4, which will be explained below. And, a numerical reference (7) designates a mounting hole, installed at an upper center of the hanger portion (5). The number of the mounting hole (7) is not limited to one, it is also possible to be two or more.

The polarizing lens element (6) obtained as above is then welded and integrated with the plastic substrate (21) using the injection molding. FIG. 3 is a vertical sectional view showing that a pair of male and female molds of an injection-molding device is open. A numerical reference (11)

is a fixed female mold, while a numerical reference (12) is a male mold, facing with the female mold (11) and moving by repeatedly pressing, contacting and separating from the female mold. FIG. 4 is a front view of the female mold (11) and FIG. 5 is a front view of the male mole (12). At the female mold (11), a circular concave portion (11a) is formed, while a circular convex portion (12a) is formed to the male mold (12) to face with the circular concave portion. When the female and male molds (11) (12) are pressing and contacting each other, the circular concave portion (11a) and the circular convex portion (12a) forms a cavity. A numerical reference (13) is a main runner for supplying a predetermined amount of plastic materials toward the cavity to an arrowed direction to form the melt plastic substrate (21) using an extruding machine (not shown). Numerical references (14) and (14') are runners, which reach a gate (15) for finally supplying the plastic materials from the main runner (13) to the cavity. The gate (15), in the present embodiment, has a configuration that forms an flat opening with a broad width, gradually widened and opened inward the cavity in order to inflow the melt plastic materials into the cavity regularly, so not causing deformation in the plastic substrate (21). A numerical reference (16) is a support means for mounting the polarizing lens element (6) inserted out of a circumference of the circular concave portion (11a), and the support means is a pin, which supports the polarizing lens element (6) with

inserting and hanging the polarizing element (6) in the mounting hole (7) of the hanger portion (5), in this embodiment as a preferred example as shown FIG 3. In this supporting state, the polarizing lens element (6) is mounted to be a bit movable, smoothly along an inner of the circular concave portion (11a), with putting the concave surface outward. The pin (16) shown in FIG. 3 is vertically fixed to the female mold surface (11), but not limited to that case, it is also possible to use a movable pin (16), which is retracting when the male mold (12) presses and contacts using a spring mounted in the female mold (11) and protruding when separated from the male mold, and the number of the pin (16) is not only one but also more than two. In this case, the number and position of the pin (16) correspond to the mounting hole (7) of the polarizing lens element (6), of course. In addition, the reference number (17) is an entry hole of the pin (16), which is fixed to the female mold (11), and it is not necessary if the pin (16) is a movable pin. The reference number (18) is a common jet pin, which separates a formed material from the female mold (11) after the forming process and then pushes the material from the male mold (12).

Next, the melting and integrating process of the polarizing lens element (6) and the plastic substrate (21) is explained in a suitable order. At first, after separating the male mold (12) from the female mold (11), the polarizing lens element (6) is mounted to the mounting hole (7) with

being hung to the pin (16). Therefore, at this time, the convex surface of the polarizing lens element (6) is gently mounted because it accords with a surface of the circular concave portion (11a), not to be attached thereto. If two or more pins (16) are used, relative positions of the polarizing lens element (6) and the circular concave portion (11a) are more reliably coincided. At the same time, the male mold (12) is moved to contact and press the female mold (11), then interposing the hanger portion (5) of the polarizing lens element (6) therebetween, and at the same time pushing up the plastic material through the gate (15) into a curved cavity formed by the circular concave portion (11a) and the circular convex portion (12a). At this time, because the polarizing lens element (6) is interposed to the hanger portion (5) but the sphere R portion contacts with the surface of the circular concave portion at a surface of the transparent coating (2) to be a bit movable in the cavity, the plastic material is smoothly charged to cover the combining surface of the transparent coating (3) without excessive resistance in injection of the melt plastic material, so preventing from forming cockle thereof or crack on the polarizing element (1). Now, when using, as the polarizing lens element (6), one made by cutting off a bit inner portion (for example, 1 ~ 2mm) from a circular peripheral of the sphere R of the polarizing sheet (4) obtained by the preparatory forming process, the plastic material may be more smoothly charged, so giving better results. According to such processes, the plastic

material is flowed as if suppressively attaching the polarizing lens element (6) on the surface of the circular concave portion (11a) at its concave surface, and the plastic material is charged in the cavity, and, at the same time, melt, integrated with the combining surface of the transparent coating (3) and hardened. As a result, the surface of the transparent coating (2) and the surface of the plastic substrate, formed by injecting the plastic material, obtain a curved laminated material by the circular concave portion (11a) and the circular convex portion (12a), respectively. And, the obtained curved laminated material separates the female and male molds (11) and (12) apart and takes them out of the injection molding machine using the jet pin (18). After that, the above processes are repeated.

The curved laminated material obtained as above is, as shown in FIG. 6, grinded at its peripheral into a predetermined shape to form a desired polarizing plastic lens (22). Also, on the surface of the curved laminated material, a hardening film may be selectively formed according to various well-known manners.

Other than the above embodiment, a polarizing plastic lens (42) may be obtained, in which the polarizing lens element (6) is arranged to the concave surface and the plastic substrate (21) is arranged to the convex surface, as shown in FIG. 7. This modification has no difference from the method of obtaining the above polarizing plastic lens (22) in principle except the following, which are described

in brief.

At first, when preforming the polarizing lens element (6) from the polarizing sheet (4), the concave surface is adopted as the transparent coating (2) and the convex surface is adopted as the transparent coating (3) having the combining surface, and other configurations are identical to those in FIG. 1. And, the injection-molding machine has a little structural and operational difference. In other words, as shown in FIG. 8, a gate (35) for finally supplying the plastic material to the cavity is mounted to a circular concave portion (31a) of a female mold (31), and the polarizing lens element (6) is smoothly mounted to accord (correspond) to a surface of a circular concave portion (32a) with positioning the transparent coating (3) having the combining surface, namely the convex surface, outward. Therefore, a pin (36) is inserted to an outer circumference of the circular concave portion (32a), as a support means. According to those, if processed like the above embodiment, the plastic material is injected and charged from the circular concave portion (32a) and then melt, integrated and fixed to the convex surface of the polarizing lens element (6). Therefore, similarly to the above embodiment, it may obtain a polarizing plastic lens (42), which has the polarizing lens element (6) at the concave surface and the plastic substrate (21) at the convex surface.

As described above, the present invention smoothly mounts the polarizing lens element to accord to the inner of

the mold so to be melt and integrated to the melt plastic material by using the common injection molding process, so it may obtain a polarizing plastic lens without optical defects because the polarizing element is not cracked, the transparent coating is not cockled or broken, and the surfaces of the transparent coating and the plastic substrate are satisfactorily finished. In addition, by using the injection molding manner, the polarizing lens element and the plastic substrate can be integrated within a much shorter time than the case of the conventional method, so it is very efficient and suitable for the mass production of the polarizing plastic lens.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing the configuration of a preformed polarizing sheet, FIG. 2 is a partially broken plane view showing a polarizing lens element, seen from a convex surface, FIG. 3 is a vertically partially broken view showing that female and male molds of an injection molding machine are spaced apart, FIGs. 4 and 5 are front views showing the female mold and the male mold, respectively, FIG 6 is a sectional view showing a polarizing plastic lens obtained by one embodiment of the present invention, FIG. 7 is a sectional view showing a polarizing plastic lens obtained by another embodiment of the present invention and FIG. 8 is a vertically partially broken view showing main portions of which the female and male molds of the injection molding machine for obtaining the polarizing plastic lens of

FIG. 7 are spaced apart.

(1)...polarizing element (2)...polarizing sheet

(5)...hanger portion (6)...polarizing lens element

(11)(31)...female mold (11a)(31a)...circular concave portion

(12)(32)...male mold (12a)(32a)...circular convex portion

(16)(36)...pin (support means) (21)...plastic substrate

(22)(42)...polarizing plastic lens

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図に示す偏光レンズ素子(6)を凹面側に、プラスチック基層(2)を凸面側に有する偏光プラスチックレンズ(8)を得ることができる。

本発明は、以上述べた通り通常の射出成形法を利用することにより、偏光レンズ素子を金型内に位置せるようにして軽く接着した状態でその結合性表面に溶融状態のプラスチック材料と溶融一体化するものであるから、偏光素子に亀裂を生じたりすることがなく、また透明被覆層にしわが生じたり、破れたりすることもなく、しかも透明被覆層およびプラスチック基層の表面が極めて良好に仕上がるので、光学的欠点の無い偏光プラスチックレンズを得ることができる。また射出成形法を利用するため、従来の方法に比べ偏光レンズ素子とプラスチック基層との一体化が極めて短時間になし得られて効率的

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てあり、偏光プラスチックレンズの製造に適している。

4 図面の簡単な説明

図面はいずれも本発明の一実施例を示すものであり、第1図は予備成形された偏光シートの構成を示す断面図、第2図は偏光レンズ素子を示す凸面側からみた部分切欠平面図、第3図は射出成形装置の雌雄金型の開反した状態を示す部分縦断面図、第4図は雌金型を、また第5図は雄金型をそれぞれ示す正面図、第6図は本発明の一実施例によつて得られる偏光プラスチックレンズを示す断面図、第7図は他の実施例によつて得られる偏光プラスチックレンズを示す断面図、第8図は第7図で示す偏光プラスチックレンズを得るための射出成形装置の雌雄金型を開反せしめた状態でその要部を示す部分縦断

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面図である。

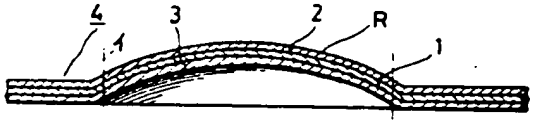
(1)…偏光素子、(4)…偏光シート、(5)…支持片、(6)…偏光レンズ素子、(11)(31)…雌金型、(11a)(31a)…円形凹部、(12)(32)…雄金型、(12a)(32a)…円形凸部、(18)(38)…ピン(支持手段)、(20)…プラスチック基層、(28)…偏光プラスチックレンズ。

以上

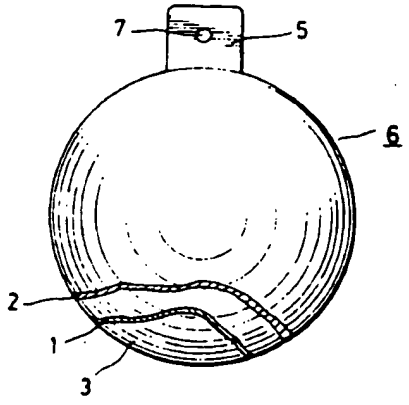
特許出願人 岩吉光学工業株式会社

代理人 弁理士 浦 永 久 最

第1図



第2図



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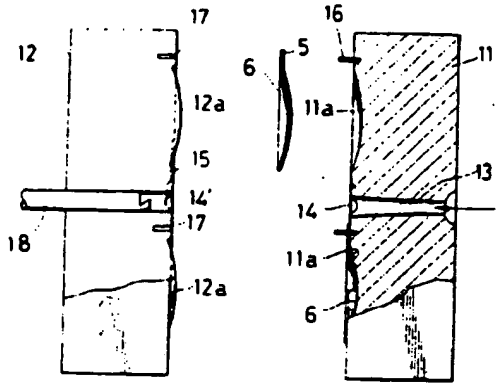
第３図



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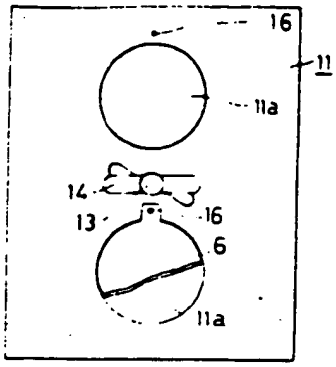
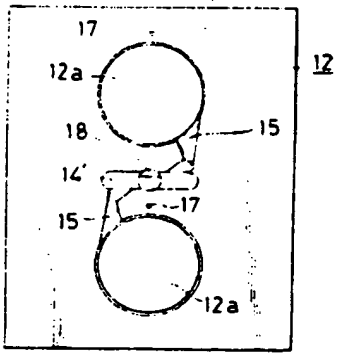


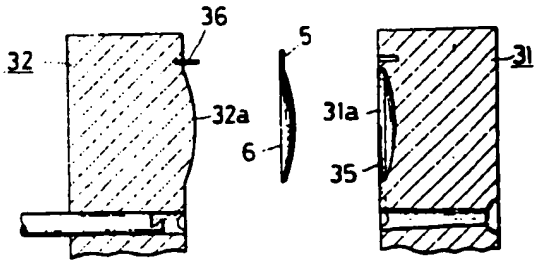
第５図



第６図

第７図

第８図



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Japanese Patent Laid-Open No. 13139/1981

(Public Date: Feb, 9, 1981)

(3)

SPECIFICATION

1. TITLE OF THE INVENTION

METHOD OF MAKING POLARIZING PLASTIC LENS

2. CLAIMS

1. A method of making a polarizing plastic lens comprising the steps of: preforming polarizing sheets in a spherical shape, in which one of transparent coatings laminated to both sides of a polarizing element is a combining surface to be laminated to a plastic substrate formed thereof; forming a polarizing lens element by cutting the preformed polarizing sheet with leaving a part of a flat portion at an outer circumference of the spherical polarizing sheet as a hanger portion; supporting the hanger portion to a support means installed out of a peripheral of a pair of mold circular concave portions or a circular convex portion which forms at least one cavity with a curvature substantially similar to the polarizing lens element, in order to mount the polarizing lens element to a surface of the circular concave portion or circular convex portion at a gentle slope in manner of putting the combing surface as a outer surface; and welding and integrating the plastic substrate to the combining surface of the polarizing lens element by compressively combining both the concave mold and the convex mold and charging melt plastic material into the cavity at the same time.

2. The method of making a polarizing plastic lens of claim 1, wherein the support means is a pin inserted into the outer circumference of the circular concave or convex portion.

3. The method of making a polarizing plastic lens of claim 1, wherein the diameter of the polarizing lens element is small than that of the cavity.

3. DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a method of making a plastic polarizing lens used for an anti-dazzle polarizing lens.

Conventionally, the plastic polarizing lens in a structure that a polarizing element with optical anisotropy is laminated with a transparent plastic layer is well known. For example as a method of making such a kind of lens, Japanese Patent Gazette Publication No.S53-29711 discloses a method of using a so-called cast manner, which forms a complex plastic polarizing lens by arranging a preformed polarizing element in a spherical shape in a airspace formed by a mold consisting of a concave surface and a convex surface, supplying polymerized plastic monomers at both sides of the polarizing element, and then polymerizing them as they are. And, Japanese Patent Gazette Publication No.S50-3656 discloses a method of using a so-called press forming manner, which, with a laminated material having two thermoplastic

layers with different thickness at both sides of a polarizing lamina, presses the thinner thermoplastic layer inserted between a concave press plate and a convex press plate of the press toward the convex press plate. However, the former should heat and polymerize the polymerized plastic monomers together with the mold during a sufficient time, so giving bad efficiency due to the long manufacturing time, and there are additional drawbacks like it needs several pairs of molds to enhance the efficiency. Moreover, in the later method, the polarizing laminar tends to create cracks owing to strains of the thermoplastic layers at both sides thereof when the polarizing laminar is pressed by the convex press plate, and the method has more defects that the polarizing laminar tends to recover its original state after the forming and there is a serious limitation in temperature and pressure conditions applied to the heating press.

An object of the present invention is to provide a method of making a plastic polarizing lens with better manufacturing efficiency, which also eliminates such conventional drawbacks. That is, the object of the present invention is to provide a method of making a plastic polarizing lens, which includes preforming polarizing sheets in a spherical shape, in which one of transparent coatings laminated to both sides of a polarizing element is a combining surface to be laminated to a plastic substrate formed thereof; forming a polarizing lens element by cutting the preformed polarizing sheet with leaving a part of a flat

portion at an outer circumference of the spherical polarizing sheet as a hanger portion; supporting the hanger portion to a support means installed out of a peripheral of a pair of mold circular concave portions or a circular convex portion which forms at least one cavity with a curvature substantially similar to the polarizing lens element, in order to mount the polarizing lens element to a surface of the circular concave portion or circular convex portion at a gentle slope in manner of putting the combing surface as a outer surface; and welding and integrating the plastic substrate to the combining surface of the polarizing lens element by compressively combining both the concave mold and the convex mold and charging melt plastic material into the cavity at the same time, wherein the spherical laminated material is made into the plastic polarizing lens by grinding its periphery into a predetermined lens shape.

The polarizing element used in the present invention is a transparent film configuration with the optical anisotropy, which may be, for example, a polyvinyl alcohol film having molecular substantially oriented to one axis and at the same time treated with urea or 2-color dye or one made by treating the polymer having polyene by the dehalogenation hydrogen reaction of halogenide vinyl polymer with 2-color dye and having molecular oriented to one axis. And, the transparent coatings laminated to both sides of the polarizing element act for protecting the polarizing element, and as the transparent coating, a film consisting of thermoplastic

cellulose derivative such as cellulose acetate, cellulose tri-acetate, cellulose acetate butylate, etc., other acrylic film, vinyl chloride film, and so on may be adopted, and it becomes the polarizing sheet by being laminated to the common polarizing element using adhesive.

In this case, at least one of the transparent coatings laminated to both sides of the polarizing element has a laminating characteristic to a plastic substrate explained below, or its surface has a laminating characteristic by interposing a heat-sensitive adhesive paint film made of, for example, vinyl chloride film, ABS film, acrylic film or acrylic resin, and it has a surface which exhibits a combining characteristic toward the plastic substrate in melting. And, the transparent coating having the combining surface is selectively used depending on the kind of the plastic substrate.

In addition, as the plastic substrate used in the present invention, the acrylic polymer like polymetylmetacrylate is suitable.

Hereinafter, the present invention is described in detain with reference to the drawings showing embodiments. In addition, considering the laminating configuration of the polarizing lens element and the plastic substrate, it can be optionally selected which one is laminated to a concave portion and which other one is laminated to a convex portion in the present invention, but in the embodiments explained below, the explanation will be mainly based on the case that

the polarizing lens element is laminated to the convex portion and the plastic substrate is to the concave portion.

Fig. 1 is shows that a polarizing sheet (4) in which transparent coatings (2) and (3) are laminated on both sides of a polarizing element is preformed on a sphere R so that the transparent coating (3) becomes concave by a heating press. The sphere R has diameter and curvature substantially equal to those of a circular concave portion. At this case, the transparent coating (2) toward a convex surface is a film made of a thermoplastic cellulose derivative, while the transparent coating (3) toward the concave surface is a acrylic film. A thickness of each layer constituting the polarizing sheet (4) is determined to maintain the optical anisotropy of the polarizing element (1) and a concave and convex surface condition of the sphere R at their optimal states, and it is important that each layer should have a suitable thickness to prevent creation of cockle or breakage of the polarizing sheet (4) and, more than else, cracking on the polarizing element (1). And, a thickness of the polarizing sheet (4) is determined so that a laminated thickness after being integrated with a plastic substrate explained below should be suitable to the polarizing plastic lens, which is the finally-purposed product. Therefore, preferably, the polarizing element (1) has a thickness of 15μ ~ 75μ, the transparent coating (2) has a thickness of 35μ ~ 350μ, and the transparent coating (3) has a thickness of 30μ ~ 200μ. The preparatory forming method needs any special

process, but just positioning the transparent coating (2) between a convex mold heated to 130°C ~ 150°C and a concave mold at a room temperature to contact with the concave mold, pressing the convex mold from the transparent coating (3) to the concave mold to put the transparent coating (2) thereinto, and then taking out and cooling it.

FIG. 2 shows a polarizing lens element (6), cutting with leaving a part of an outer circumferential flat portion of the sphere R of the polarizing sheet (4) obtained by the preparatory forming process as a hanger portion (5). In this case, besides cutting the circumferential peripheral of the sphere R, it is also possible to cut off a position a bit inside the circumferential peripheral (shown as a broken line (イ) in FIG. 1), which may give preferable results to integration with a plastic substrate (21) explained below. The hanger portion (5) plays a role of mounting the polarizing lens element (6) by using a support means (16) shown in FIGs. 3 and 4, which will be explained below. And, a numerical reference (7) designates a mounting hole, installed at an upper center of the hanger portion (5). The number of the mounting hole (7) is not limited to one, it is also possible to be two or more.

The polarizing lens element (6) obtained as above is then welded and integrated with the plastic substrate (21) using the injection molding. FIG. 3 is a vertical sectional view showing that a pair of male and female molds of an injection-molding device is open. A numerical reference (11)

is a fixed female mold, while a numerical reference (12) is a male mold, facing with the female mold (11) and moving by repeatedly pressing, contacting and separating from the female mold. FIG. 4 is a front view of the female mold (11) and FIG. 5 is a front view of the male mole (12). At the female mold (11), a circular concave portion (11a) is formed, while a circular convex portion (12a) is formed to the male mold (12) to face with the circular concave portion. When the female and male molds (11) (12) are pressing and contacting each other, the circular concave portion (11a) and the circular convex portion (12a) forms a cavity. A numerical reference (13) is a main runner for supplying a predetermined amount of plastic materials toward the cavity to an arrowed direction to form the melt plastic substrate (21) using an extruding machine (not shown). Numerical references (14) and (14') are runners, which reach a gate (15) for finally supplying the plastic materials from the main runner (13) to the cavity. The gate (15), in the present embodiment, has a configuration that forms an flat opening with a broad width, gradually widened and opened inward the cavity in order to inflow the melt plastic materials into the cavity regularly, so not causing deformation in the plastic substrate (21). A numerical reference (16) is a support means for mounting the polarizing lens element (6) inserted out of a circumference of the circular concave portion (11a), and the support means is a pin, which supports the polarizing lens element (6) with

inserting and hanging the polarizing element (6) in the mounting hole (7) of the hanger portion (5), in this embodiment as a preferred example as shown FIG 3. In this supporting state, the polarizing lens element (6) is mounted to be a bit movable, smoothly along an inner of the circular concave portion (11a), with putting the concave surface outward. The pin (16) shown in FIG. 3 is vertically fixed to the female mold surface (11), but not limited to that case, it is also possible to use a movable pin (16), which is retracting when the male mold (12) presses and contacts using a spring mounted in the female mold (11) and protruding when separated from the male mold, and the number of the pin (16) is not only one but also more than two. In this case, the number and position of the pin (16) correspond to the mounting hole (7) of the polarizing lens element (6), of course. In addition, the reference number (17) is an entry hole of the pin (16), which is fixed to the female mold (11), and it is not necessary if the pin (16) is a movable pin. The reference number (18) is a common jet pin, which separates a formed material from the female mold (11) after the forming process and then pushes the material from the male mold (12).

Next, the melting and integrating process of the polarizing lens element (6) and the plastic substrate (21) is explained in a suitable order. At first, after separating the male mold (12) from the female mold (11), the polarizing lens element (6) is mounted to the mounting hole (7) with

being hung to the pin (16). Therefore, at this time, the convex surface of the polarizing lens element (6) is gently mounted because it accords with a surface of the circular concave portion (11a), not to be attached thereto. If two or more pins (16) are used, relative positions of the polarizing lens element (6) and the circular concave portion (11a) are more reliably coincided. At the same time, the male mold (12) is moved to contact and press the female mold (11), then interposing the hanger portion (5) of the polarizing lens element (6) therebetween, and at the same time pushing up the plastic material through the gate (15) into a curved cavity formed by the circular concave portion (11a) and the circular convex portion (12a). At this time, because the polarizing lens element (6) is interposed to the hanger portion (5) but the sphere R portion contacts with the surface of the circular concave portion at a surface of the transparent coating (2) to be a bit movable in the cavity, the plastic material is smoothly charged to cover the combining surface of the transparent coating (3) without excessive resistance in injection of the melt plastic material, so preventing from forming cockle thereof or crack on the polarizing element (1). Now, when using, as the polarizing lens element (6), one made by cutting off a bit inner portion (for example, 1 ~ 2mm) from a circular peripheral of the sphere R of the polarizing sheet (4) obtained by the preparatory forming process, the plastic material may be more smoothly charged, so giving better results. According to such processes, the plastic

material is flowed as if suppressively attaching the polarizing lens element (6) on the surface of the circular concave portion (11a) at its concave surface, and the plastic material is charged in the cavity, and, at the same time, melt, integrated with the combining surface of the transparent coating (3) and hardened. As a result, the surface of the transparent coating (2) and the surface of the plastic substrate, formed by injecting the plastic material, obtain a curved laminated material by the circular concave portion (11a) and the circular convex portion (12a), respectively. And, the obtained curved laminated material separates the female and male molds (11) and (12) apart and takes them out of the injection molding machine using the jet pin (18). After that, the above processes are repeated.

The curved laminated material obtained as above is, as shown in FIG. 6, grinded at its peripheral into a predetermined shape to form a desired polarizing plastic lens (22). Also, on the surface of the curved laminated material, a hardening film may be selectively formed according to various well-known manners.

Other than the above embodiment, a polarizing plastic lens (42) may be obtained, in which the polarizing lens element (6) is arranged to the concave surface and the plastic substrate (21) is arranged to the convex surface, as shown in FIG. 7. This modification has no difference from the method of obtaining the above polarizing plastic lens (22) in principle except the following, which are described

in brief.

At first, when preforming the polarizing lens element (6) from the polarizing sheet (4), the concave surface is adopted as the transparent coating (2) and the convex surface is adopted as the transparent coating (3) having the combining surface, and other configurations are identical to those in FIG. 1. And, the injection-molding machine has a little structural and operational difference. In other words, as shown in FIG. 8, a gate (35) for finally supplying the plastic material to the cavity is mounted to a circular concave portion (31a) of a female mold (31), and the polarizing lens element (6) is smoothly mounted to accord (correspond) to a surface of a circular concave portion (32a) with positioning the transparent coating (3) having the combining surface, namely the convex surface, outward. Therefore, a pin (36) is inserted to an outer circumference of the circular concave portion (32a), as a support means. According to those, if processed like the above embodiment, the plastic material is injected and charged from the circular concave portion (32a) and then melt, integrated and fixed to the convex surface of the polarizing lens element (6). Therefore, similarly to the above embodiment, it may obtain a polarizing plastic lens (42), which has the polarizing lens element (6) at the concave surface and the plastic substrate (21) at the convex surface.

As described above, the present invention smoothly mounts the polarizing lens element to accord to the inner of

the mold so to be melt and integrated to the melt plastic material by using the common injection molding process, so it may obtain a polarizing plastic lens without optical defects because the polarizing element is not cracked, the transparent coating is not cockled or broken, and the surfaces of the transparent coating and the plastic substrate are satisfactorily finished. In addition, by using the injection molding manner, the polarizing lens element and the plastic substrate can be integrated within a much shorter time than the case of the conventional method, so it is very efficient and suitable for the mass production of the polarizing plastic lens.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing the configuration of a preformed polarizing sheet, FIG. 2 is a partially broken plane view showing a polarizing lens element, seen from a convex surface, FIG. 3 is a vertically partially broken view showing that female and male molds of an injection molding machine are spaced apart, FIGs. 4 and 5 are front views showing the female mold and the male mold, respectively, FIG 6 is a sectional view showing a polarizing plastic lens obtained by one embodiment of the present invention, FIG. 7 is a sectional view showing a polarizing plastic lens obtained by another embodiment of the present invention and FIG. 8 is a vertically partially broken view showing main portions of which the female and male molds of the injection molding machine for obtaining the polarizing plastic lens of

FIG. 7 are spaced apart.

(1)...polarizing element (2)...polarizing sheet

(5)...hanger portion (6)...polarizing lens element

(11)(31)...female mold (11a)(31a)...circular concave portion

(12)(32)...male mold (12a)(32a)...circular convex portion

(16)(36)...pin (support means) (21)...plastic substrate

(22)(42)...polarizing plastic lens

図に示す偏光レンズ素子(6)を凹面側に、プラスチック基層(2)を凸面側に有する偏光プラスチックレンズ(12)を得ることができる。

本発明は、以上述べた通り通常の射出成形法を利用することにより、偏光レンズ素子を金型内に位置せるようにして軽く装着した状態でその結合性表面に溶融状態のプラスチック材料と密着一体化するものであるから、偏光素子に亀裂を生じたりすることがなく、また透明被覆層にしわが生じたり、破れたりすることもなく、しかも透明被覆層およびプラスチック基層の表面が極めて良好に仕上がるので、光学的欠点の無い偏光プラスチックレンズを得ることができる。また射出成形法を利用するため、従来の方法に比べ偏光レンズ素子とプラスチック基層との一体化が極めて短時間になし得られて効率的

(3)

てあり、偏光プラスチックレンズの量産に適している。

4 図面の簡単な説明

図面はいずれも本発明の一実施例を示すものであり、第1図は予備成形された偏光シートの構成を示す断面図、第2図は偏光レンズ素子を示す凸面側からみた部分切欠平面図、第3図は射出成形装置の雌雄金型の離反した状態を示す部分縦断面図、第4図は雌金型を、また第5図は雄金型をそれぞれ示す正面図、第6図は本発明の一実施例によつて得られる偏光プラスチックレンズを示す断面図、第7図は他の実施例によつて得られる偏光プラスチックレンズを示す断面図、第8図は第7図で示す偏光プラスチックレンズを得るための射出成形装置の雌雄金型を離反せしめた状態でその要部を示す部分縦断

(4)

面図である。

(1)…偏光素子、(4)…偏光シート、(5)…支持片、(6)…偏光レンズ素子、(11)(31)…雌金型、(11a)(31a)…円形凹部、(12)(32)…雄金型、(12a)(32a)…円形凸部、(16)(36)…ピン(支持手段)、(2)…プラスチック基層、(12)(32)…偏光プラスチックレンズ。

以上

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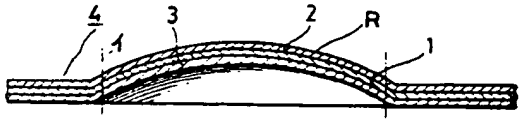
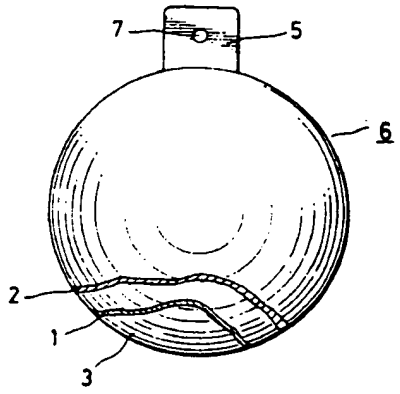
代理人 弁理士 唐 水 久 雄

(2)

第1図



第2図



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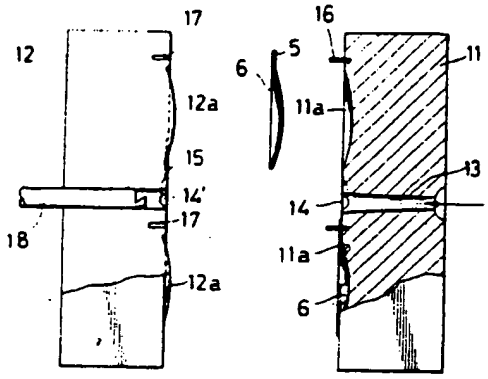
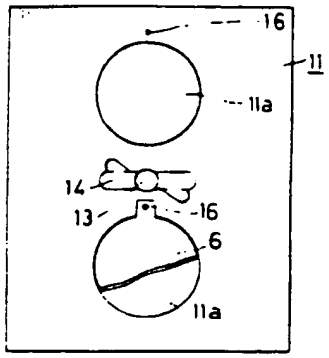
第 3 図



第 4 図



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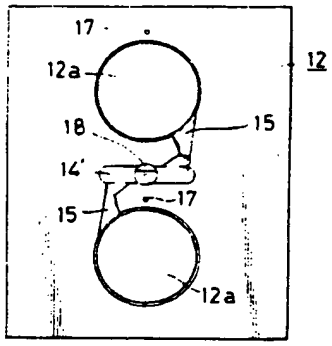
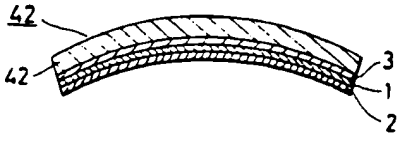
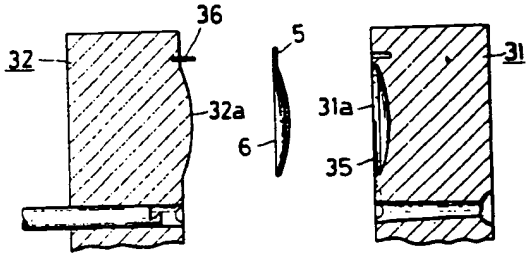


第 6 図

第 7 図



第 8 図



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